

Has the time come ...?

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“The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them”. William Bragg ⁽¹⁾

Democritus was the first that proposed that matter is divided in small parts that are undivided and he called these parts “atoms”. Nowadays we know that atoms could be divided but their properties are changed and these smaller “parts” are called subatomic particles. Although the number of subatomic particles is ever increasing, we “know” that the division of quantum particles to even smaller parts is impossible as we get inconsistent results. These smallest parts are called quanta. So we have quanta of energy, that are equivalent to quanta of matter (according to $E=mc^2$). Lately quantized space and time have been proposed in an attempt to explain experimental data.

As humans are trying to explain everything, in other words to be deterministic, they make use of appropriate basic tools. Among them are Cartesian coordination system ⁽²⁾ and the continuum of its axes. The increasing evidence of quantized physical quantities, forces this reference system and all the other straightly related to it (spherical and cylindrical system) to their limits. Nobody dares to propose something new that would include quanta and discretion as basic characteristics and the “impossibility of knowing” as an unavoidable fact. The necessity of the first (quanta and discretion) is already obvious to modern physics and the necessity of the later (impossibility of knowing) is shown since 1931 by Kurt Gödel and his two incompleteness theorems ⁽³⁾.

After all, is Cartesian coordination system (CCS) appropriate for physical reality? Does CCS impose relations that depart from natural logic?

CCS uses negative numbers. Is there any physical meaning of negative numbers? NO. Is there a meaning by saying “the distance is -5m?” or “the length is -2m?” These expressions are implying that the measurement is done by inverting the start and the end. What we meant by “I have -5 apples?”, that I owe 5 apples while I have none. It is obvious that negative numbers are distortion of physical logic. The problem of imaginary numbers (as result of negative number’s use) in physics is well known and nothing can be said to give it a physical reasoning. Are the axes of CCS equivalent and symmetric? In order to be symmetric the origin should be expressed by $X=Y=Z$ (for 3D space). This is not the case in CCS where $X=Y=Z$ is not the origin. The only reason (not ignorable at all) that CCS is in use is because of Pythagorean Theorem. However it should be mentioned that the Pythagorean Theorem makes use of the square of the quantities (e.g. length) and not the quantities themselves, and it is known that the square of a negative number is equal to the square of its absolute (positive) value.

As it is shown, the physical meaning of negative values is generally different from that of positive values which make addition and subtraction (logically) “problematic”.

Actually, each axis in CCS is consisted of two (semi)axes with opposite directions. So for 3D space we have six axes (3 positive and 3 negative). These are symmetric (but not equivalent, as X_- has a special relation with X_+ and not with Y_+).

Apart from all these undesirable properties of CCS, we added some more for our convenience. We convinced ourselves, that moving the origin and interchanging axes according to our wish is unrelated to the conceivable image of the universe. However, a “point” (Big Bang) is probably “steady” and obviously a reasonable origin for any physical coordination system that is supposed to represent physical reality. It is obvious that the line that connects the origin with the point of measurement should possess a special role. Unfortunately this direction is the only one that we cannot realize as it connects any point with its past (real past) or its future (imaginary wave).

After all, is there a symmetric coordination system with equivalent axes that could incorporate: past and future, discreteness and continuum, materiality and spirituality, “real” and “virtual”?

Let us consider 1D space (line).

This space is represented in CCS by one axis (X). The coordination system that would have a fixed origin and the minimum number of equivalent and symmetric axes should be consisted by the two (semi)axes of CCS (X_- , X_+). Because in the desirable system axes should start from the origin and should have only positive values, we keep X_+ (as in CCS) and replace X_- by Φ (from Greek Φανταστικός – Imaginary). It should be emphasized that Nature is represented by two coexisting and

inseparable coordination systems: the Real Coordination System (RCS) and the Virtual Coordination System (VCS). In “real” world we have perception of what is represented by RCS while VCS is unconceivable to us. RCS has two axes one real (X) and one virtual (Φ) while VCS has the axes Φ_x (virtual) and R (real). This coordination system that we propose is called Natural Coordination System (NCS).

The real concept is static, observable and self-consistent while the virtual concept is dynamic, unobservable and interconnected.

The behavior of the imaginary axes (Φ_x , Φ) is opposite by all means to the behavior of the real ones (X, R). Their directions are opposite ($X - \Phi$ and $\Phi_x - R$), origin has the values 0 (zero) for real axes and ∞ (infinity) for virtual axes, values are increasing as we depart from origin for real axes while they are “decreasing” for virtual axes. Drawing these two axes (X, Φ) of RCS and the two axes (Φ_x , R) of VCS to infinity we get two circles (whose diameter is related to the maximum value (infinity) of $X \equiv \infty$ (or the “minimum” value of $\Phi_x \equiv \infty$)).

On real axis X, each point (e.g. P) has a conjugated point P' on Φ axis (Fig. 1). Two conjugated points (P, P') are symmetric about origin-start ($\equiv \infty$, end). Any point is represented by a RCS as a real point (P) and by a VCS as a virtual point (P'). These two “points” (P, P') are always conjugated and consist the natural reality of the point (P).

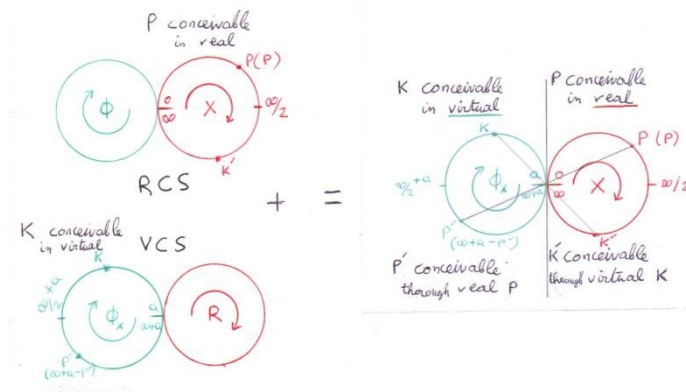


Figure 1

The two coordination systems (RCS and VCS) have theoretically different starting (ending) points (Fig. 2). However the distance between them is half the quantum of real (or virtual) space (Plank's length) and its detection is impossible in any way.

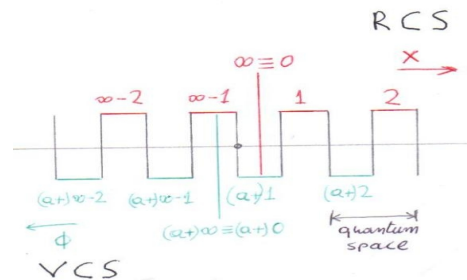


Figure 2

For 1D space, because of symmetry, the two coordination systems (real and virtual) are similar and for our convenience we could consider Φ_x and Φ interchangeable (although their symmetry differs). For RCS the value on Φ axis for point P (∞ -P') - in a “close” system – is “equal” (not equivalent) to the value on X axis (P). The nature of these values is “opposite” which means that if we conceive X as e.g. length (real) we cannot conceive Φ (in any possible way, e.g. time). The natural meaning of Φ axis includes the connection between the system's RCS with the Whole. As no system is close, there is always a connection (α) between any system under examination with the rest Whole (the rest of the systems).

Things are not so “simple”. The System under Examination (SuE) can be disclosed by RCS (through real axis X) up to $P=\infty/2$. For $P>\infty/2$ SuE is disclosed by virtual coordination system (through Φ axis). For example if our SuE can get five (5) distinctive real values (1,2,3,4,5) Figure 3 is appropriate.

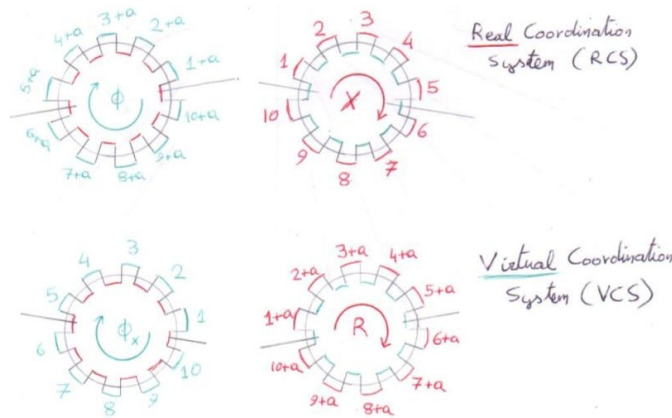


Figure 3

The disclosed values, as P is moving on X axis clockwise, are:

On X axis (real) 1 2 3 4 5 1 2 3 4 5 ...

On Φ_x axis (virtual) 5 4 3 2 1 5 4 3 2 1 ...

A real "observer" will be able to conceive the real part, hence the sequence 1 2 3 4 5 1 2 3 4 5 ... without any interruption. In contrast, a virtual "observer" will realize the virtual part 5 4 3 2 1 5 4 3 2 1 5 4 3 2 1 ...

Let us consider 2D space (plane).

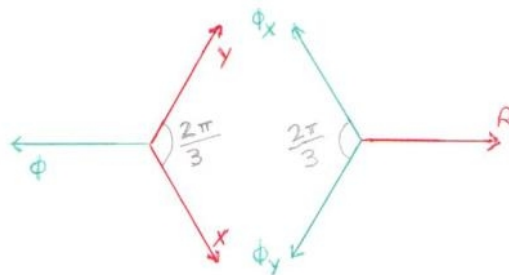
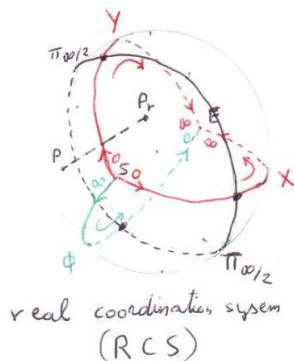


Figure 4

There are two real axes (X, Y) and one virtual axis (Φ) in Real Coordination System (RCS) and two virtual axes (Φ_x, Φ_y) and one real axis (R) in Virtual Coordination System (VCS) as shown in Figure 4. In RCS the start (origin) S has the value 0 (zero) on X and Y axes and the value ∞ (infinity) on Φ axis. X and Y values are increasing following the arrows (Fig. 4) but Φ value is "decreasing" (the opposite is true for VCS). The angle between any two axes is $2\pi/3$. If we imagine axes going to "infinity" we get a spherical surface with the start on one pole and the end on the other (Fig. 5). You can mention that in order to represent "completely" a space we use the space of next dimensionality (1D is represented by 2D; 2D is represented by 3D, and 3D by 4D). The complete natural meaning of NCS is starting to emerge.

a



b

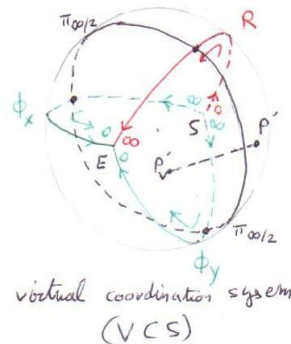


Figure 5

In Figure 5 we draw RCS and VCS in a distance only for clarity reasons. These two sub-spaces are connected to the start (S) or the end (E) (by transferring VCS above RCS in a way the two spheres are touched to S/E) and opposite of the common point (S/E).

A point P in 2D space (in RCS) can be either in between X-Y space (conceivable by a real “observer” with $X=Y$) or outside this area (and hence unconceivable by him). In contrast, a point P' in 2D space (in VCS) can be either in between Φ_x - Φ_y space (conceivable by a virtual “observer” with $\Phi_x=\Phi_y$) or outside this area (and hence unconceivable by him). The two points P and P' are conjugated and their point of symmetry is the common point S (or E). There is also a connection (α) to the Whole, as in 1D space, although it is ignored only for simplicity reasons.

If we examine in more details the axes in 2D space we can get Figure 6.

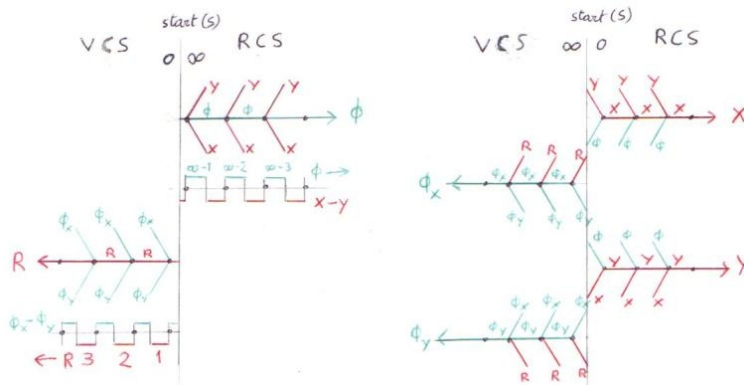


Figure 6

From Figure 6 we can realize that only the Φ axis in RCS and the R axis in VCS can be characterized following a sequence of real-virtual-real-virtual ... reality (“digital” and discrete); all other axes are unable to be characterized as digital or pure discrete.

Apart from its axes, 2D space is represented as in Figure 7c.

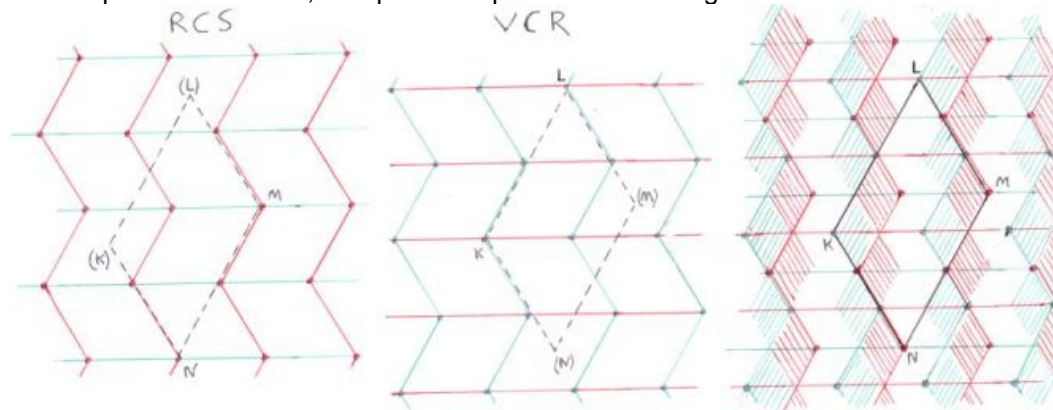


Figure 7

Rhomboid KLMN constitutes a quantum space in 2D space according to NCS. Remember that the point P on 2D space is defined in RCS where its coordination values comply: X and $Y < \infty/2$ or $X < \infty/2$ and $\Phi > \infty/2$ or $Y < \infty/2$ and $\Phi > \infty/2$, otherwise it is defined in VCS (see Fig. 5).

Let us consider 3D space (space).

As it is expected, its presentation and hence envision is rather complicated and the use of stereo models (chemistry models, e.g. $C-sp^3$) is highly recommended.

3D space is represented in NCS by four (4) symmetric axes. In RCS there are three real axes (X , Y , Z) and one virtual (Φ), while in VCS there are three virtual axes (Φ_x , Φ_y , Φ_z) and one real (R). The angle between any two axes is equal to: $\arccos(-1/3) = 2 \cdot \arctan(\sqrt{2})$

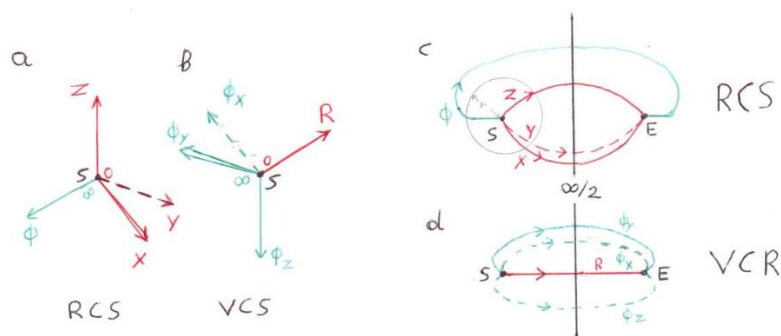


Figure 8

If we extend these four axes to infinity we get a super-sphere (Fig. 8 c, d). 3D space is represented (similarly to 2D space) by a netting of real points (RCS) plus a netting of virtual points (VCS). Each of these resembles the diamond's structure (adamantoids) and the points of one netting (e.g. real) coincide to the centers of the cavities formed by the other (virtual). This well packed "net" of points has a point density double of that of atoms in diamond (half of them real and the rest virtual). Each point is the centre of a rhombic dodecahedron. If a central point belongs to the real netting (real point, e.g. P), the surrounding dodecahedron consists of four (4) real vertices (points connected to the centre) and ten (10) virtual ones; if the central point is a virtual point (e.g. P') the surrounding dodecahedron consists of four (4) virtual vertices (points) and ten (10) real ones. Real points are connected (by quanta axes) only with real points from the real "net" (RCS); similarly virtual points are connected only with virtual points from the virtual "net" (VCS).

Three characteristic views of 3D space are shown in Figure 9.

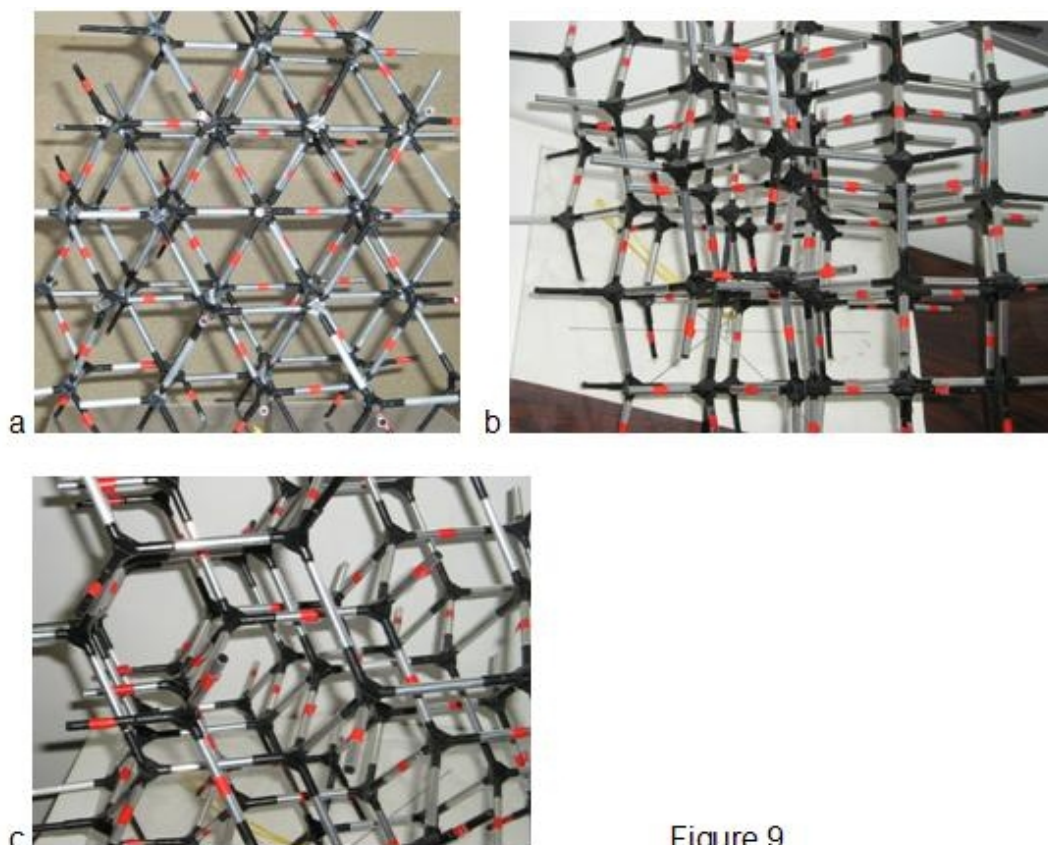


Figure 9

Discussion

Now that we have illustrated most basic properties of NCS we can take a look to the consequences on our conception of the universe:

- We already mentioned that a real observer can conceive events that happen in the real part of the respective space and can be measured by space's real axes. Hence:
 - a) In 1D space he could conceive: $1/2$ (real part of real axis) * $1/2$ (measurable ($<\infty/2$) part of real axis) * $1/2$ (because RCS is half of the whole (RCS + VCS)) = $1/8$ of the whole 1D space.
 - b) In 2D space he could conceive: $1/2$ (part that can be defined by real axes in RCS) * $1/2$ (measurable ($<\infty/2$) part of real axes) * $1/3$ (part definable by real axes) = $1/12$ of the whole 2D space.
 - c) In 3D space he could conceive: $1/2$ (part defined by real axes in RCS) * $1/2$ (measurable ($<\infty/2$) part of real axes) * $1/4$ (part definable by real axes) = $1/16$ of the whole 3D space.
- As we consider ourselves real observers and universe is believed to be planar (2D space) at each "present time" we can conceptualize only about 8% of its real part (e.g. mass) (92% remains as "dark matter" ⁽⁴⁾). In its virtual form (e.g. energy), universe retains its 3D structure and we could have indication of existence only from about 6% of its virtual part (94% remains as "dark energy" ⁽⁵⁾).
- In order to get the most physical (real) impact by our measurements, it is needed that the value for all real axes for SuE is equal ($X = Y = Z =$ distance between SuE and origin). In other words, SuE's "time line" (the line that connects SuE with origin (Big Bang)) is the extension of virtual axis (Φ) into the real space. In any other case, part of real axes' contribution is expressed only through virtual and not real space.
- It seems that some ingredients-events are able to penetrate their action through space without any restriction between real and virtual part. These ingredients-events are likely to have a relation analogue to the square of real quantities (e.g. square of length). One such composite is gravity. In contrast electromagnetic radiation is unable to act as such in virtual part and can only be expressed through R axis. In natural world four groups of ingredients could exist :
 - A) the ones that are expressed in real part of RCS (like e.g. length, velocity);
 - B) these that are expressed in RCS but through axis Φ (are related to ingredients of A group with their square value e.g. electromagnetic radiation, electron);
 - C) the ones that are expressed in virtual part of VCS through virtual axes Φ_x , Φ_y and Φ_z (normal virtual ingredients, related to the square value of ingredients of A group, e.g. gravity); and finally
 - D) the ones that are expressed in virtual part by the real axis R of VCS (these consist the abstract - collective expression of ingredients of A group into virtual part e.g. ??).
- Our spiritual existence is just an evidence of our virtual part. The special connection between real and virtual part of an entity is different from the connection to anything else that happens by a holographic process. From NCS and Special Relativity Theory we conclude that $dX/dt = dY/dt = dZ/dt = c$ and $d\Phi/dt = ic$. In other words, we can assume that - as time passes - our universe is expanding like an expanding sphere with a velocity c (c is not a constant; it increases as $c \propto r$, where r = radius of universe at time t) (see Fig 8c). Universe at "present time" (t) is represented as a spherical surface with radius $=r$ ("planar"). The surface's area in between real axes (X, Y, Z) is the present real part (physical world) while the surface's area outside real axes is the unconceivable part of the real present.
- It has been mentioned that $c \propto r$. Actually $c = r * v$ where r : universe's radius at time t , v : frequency, c : light's speed at time t . From this equation we get: (quantum frequency) $v = c/r \cong 3*10^{-6} \text{ sec}^{-1}$ (given $c \cong 300,000 \text{ km/sec}$ and $r \cong 10$ billion light years). If Plank's constant is a real constant, we get $E = h*v \cong 2*10^{-39} \text{ m}^2*\text{kg}*\text{sec}^{-2}$. Is this energy something like a quantum of energy...? If this is the case, we could get mass quantum $= E/c^2 \cong 2*10^{-56} \text{ kg}$. It is important to note that quantum length is supposed to be Plank's length ($1.6*10^{-35} \text{ m}$). Is it stable throughout universe's life? (Probably not).
- "Conjugated matter" (quantum entanglement ⁽⁶⁾) should be an unavoidable consideration in any event and hence, not a physical paradox. Everything consists of its real and its virtual part, always interconnected, inseparable and complementary. We cannot realize our virtual part as it exists in the virtual part of our universe unable to be detected. However, whenever we succeed to create a physical "entity" (e.g. photon, electron) by a physical procedure this is created as a

pair of conjugated objects (images) we might detect as their (its) whole “universe” is inside the real part of ours.

- Universe - since Big Bang (or Big Bounce ⁽⁷⁾) - expands and will continue to do so until axes get the value $= \infty/2$. During this period entropy increases, temperature decreases and causality works as we think “normal”. For the “time” after, virtual reality comes to the scene (as the conceivable reality), the universe starts to shrink, entropy decreases, temperature increases and causality works in the way we now think “abnormal”. Spiritual processes (spiritual world) will take the place of physical phenomena and materiality will be considered “magic”, as we think today about indirect evidences of our virtual counterparts. All these could be scientific fiction but there are already written, metaphorically, in many religious scripts. The big question is: “Are religions related to the natural reality?” In any case religions have to be related to Natural Philosophy if we want someday to unify natural and “super-natural” world (as we like to call whatever we are not able to understand and tackle with). The universe’s end will be a Big Annihilation followed by a Big Bang and a new start. This process (end – start – end – start ...) is the route of everything.
- We have said, at the very beginning of this essay, that Gödel’s incompleteness theorems have prohibited us to formulate a complete unified theory about whole. This implies there could be an infinite number of theories that could be proposed (more parameters than equations); but all of them are unavoidable to be incomplete or inconsistent. In other words anyone may have his own theory (or religion if you prefer) but the scope would be either to maximise its completeness (evaluate all parameters assigning a minimum axiomatic values to some of them) and/or minimise its consistency (not impose axiomatic values to too many parameters).

Let us have a brief answer for each of the questions put by this contest:

- **What we mean by “analog”, “discrete” and “digital”?**
This question has not been posed although it is the first we have to deal with before any discussion. In this essay we accept the following definitions:
“analog”: of, relating to, or being a mechanism in which data is represented by variable quantities that could be divided infinitely.
“discrete”: constituting a separate entity : individually distinct ⁽⁸⁾.
“digital”: of, relating to, or using calculation by numerical methods or by discrete units: of, relating to, or being data in the form of especially binary digits ⁽⁹⁾.
- **How can a spacetime or other continuum—with continuous symmetries—emerge from a 'digital' description?**
What is the nature of space? How would a discrete universe expand without the discreteness becoming evident? Or, does it become evident?
It depends what we mean by “continuum” and “discreteness”. As we said before, the continuum of spacetime is never interrupted; only its expression is jumping from real to virtual to real to virtual and so on. Because we are able to perceive only the part of this route expressed in real axes (parameters) it seems to us as if we live in a real “continuum” ignoring the virtual intercalations.
- **What are the implications of a minimal length, time, or energy, and how could we observe them now? Or, is this the wrong way to view fundamental discreteness?**
A quantum is a quantity that is impossible to go beyond without jumping to counterpart reality (from real to virtual or the opposite). So direct observation (measurement) of a quantum consists the limit of our possibilities.
- **Is a universe that is infinite in various ways incompatible with a digital description?**
Nothing is infinite in real reality (and everything is “infinite” in virtual reality). NCS implies “discreteness” (jumping from the one counterpart to the other) to both counterparts (real and virtual). Hence discreteness or not has nothing to do with “infinity”.
- **How is a digital description consistent with a 'flow' of time? How does causality work?**
Time is a scalar parameter (not a vector) that is expressed through Φ axis. It is impossible to conceive real reality by using virtual axis and be consisted. By using time in our theories *a priori*, we introduce inconsistency that is worthless to try to avoid (e.g. relativity theories). Causality is related to entropy (virtual) which is “decreased” in real part (“normal” causality) and “increased” in virtual part (“abnormal” causality). In real part (of reality) the cup will be broken falling from the table to the ground because of gravity (virtual) but in the virtual part it will be elevated intact up onto the table following a “probabilistic” procedure that we will not be able to conceive as we will be virtual observers and the cup will be expressed through R axis (real).

- Can the World be modeled as (or even be) a digital computation? Where does this picture lead us?

Only real part of universe could be modelled by digital computation because virtual part is above our ability to impose the appropriate rules of computation. In other words we do not know how virtual part “works” and so any “computation” is impossible. It is worth notifying that, as we said, virtual part is “inseparable” part of real reality playing a role of the same significance as the real part does. So, even real part’s computation is problematic or at least incomplete and hence stochastic.

- Are simple discrete models like cellular automata, etc., effective approaches to physics?

The answer in this question needs a more extended essay. However we could say that real part could be modelled by fractals while virtual one could be modelled by cellular automata (their distinction however is only based on what we meant by fractals or cellular automata).

- Is there a deep, foundational reason why reality must be purely analog, or why it must be digital?

In accordance to Gödel incompleteness theorems, there is always a knowable and an unknowable part of reality. These two parts could be tackled either separately (e.g. NCS) (“digital” mode) or simultaneously (“analog” mode). We believe, the later way of envision is above present human capabilities.

Finally,

Is Reality Digital or Analog?

(real reality + virtual reality = (whole) natural reality). If we mean the natural reality, only its real part can be conceived and this can happen only by discrete measuring systems (digital). However, the examination (not perception) of the natural reality could be based on methods that have to be developed and they will be far beyond “modern mathematics and physics”. Discreteness and not digitalization is the more convenient method in examining real reality in accordance to our present conception; although **the time has come** (?) to jump to a new way of thinking about natural reality, keeping always in mind that we can never conceive universe to its wholeness.

PS: The discreteness of NCS may vanish if we consider the whole coordination system spinning round start-end axis. This will be a topic for a future essay (as well as holographic interconnection of everything through virtual reality).

References

In this kind of general essays is rather inappropriate to cite certain references. However in order to comply with the rules we can cite a few general sources of information.

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